A Comparative Study of Achievement and of Costs per Unit of Pupil Progress made in Arithmetic in Rural One-room Schools and Third Class City Schools of Ford County, Kansas.

by

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VALIDATION OF THE PROBLEM

Mounting expenses of education are forcing upon educators careful analyses, comparisons, and justification of unit costs. The rural one-room school is under fire as the reputed weakest link in the American educational system. This study undertakes to measure the relative costs and the relative efficiency of arithmetic achievement in the two types of schools most common in Kansas, and nearest together in point of size, with a view to contributing toward the movement for economy of time and money. The study is made in Ford County, Kansas, including three elementary grades of rural one-room schools and third class city schools.

PREVIOUS STUDIES

A number of comparative studies have been made of rural and city schools in various states since standardized tests have come into general use.

In "A Study of Rural Schools in Travis County",[1] Norman Frost reports the results of a testing program using the Courtis Arithmetic Tests. He says,"In every instance the number of examples attempted and the number of examples worked correctly were lower in this group of country

1. University of Texas Bulletin, 1916.

schools than for the corresponding grades in Boston and Detroit and among 11,800 pupils tested in Iowa. Sometimes the difference was as great as 50 percent, the average difference being approximately 25.5 percent." Concerning the Starch test also given, he states that each grade from fourth to eighth scored below the standard established for it, the deficiencies varying from 5 to 19 percent.

In the same year, 1916, the State Board of Connecticut made a number of studies of the schools in certain townships of that state. One of the subjects was arithmetic. The report states that the accomplishment was only fair to poor in the rural schools.

The Survey and Report of the Virginia Public Schools Education Commission[1] published in 1919 gives comparative results for country and city schools. Regarding the Woody Arithmetic Tests the report says about 16,000 children were examined, of whom about 5,000 were in grades 3 to 7 or rural white schools. Of all the schools, the one-room rural school showed the poorest record. The Commission found that children in the one-room schools are on the average one grade behind children in the larger non-city schools.

E.H.Taylor in an article,"A Comparison of the Arithmetical Abilities of Rural and City School Children"[2] reports

1. Survey and Report of the Va. Public Schools Education Commission.
2. Journal of Educational Psychology, Oct.,1914.

the results of Courtis Arithmetic Tests given to most of the children in a county in Illinois. 309 children were tested in 28 schools. The scores are tabulated and compared by grades with the scores of 7008 children, published by Courtis.[1] The comparison shows that the rural schools are consistently below the others, grades 3 and 4 approximately a grade below, grades 5 and 6 are almost two grades below, grade 7 is more than one but less than two grades below, and grade 8 at least two grades below.

Richard Zeidler reports[2] tests in the rural and village schools of Santa Clara County, California. Courtis tests were given to 587 children in grades 5 to 8 inclusive. Results are compared with a group of 20 small Western cities and with Salt Lake City. He found that the rural and village schools in that county fell below the median scores for the city, being on the average two grades below Salt Lake City and one grade below the 20 small cities.

In a typical Pennsylvania county, Charles L. Harlan found[3] by using the Courtis tests that the pupils of the rural schools ranked approximately two grades below the pupils of the city schools.

The Rural School Survey of New York State under the direction of M.E.Haggerty included an extensive study of arithmetic, using the Woody tests. The results are ex-

1.Elementary School Teacher, XII: 133.
2.Elementary School Journal, XVI: 542.
3.Educational Administration and Supervision, II:560.

pressed in the statement that in no phase of the examinations did the one-teacher schools show as favorable results as the larger schools.

John M. Foote in "A Comparative Study of Instruction in Consolidated and One-teacher schools", reports a survey involving 19 states in which tests were given in various subjects to 135 consolidated and 374 one-teacher schools. The consolidated schools achieved 10 percent more in arithmetic than the one-teacher schools, there being more difference in the achievement of the upper grades than in the lower.

In the Sixty-ninth Report of the Public Schools of the State of Missouri, which gives results of 6445 pupils in grades 4 to 8 tested by the Courtis tests, we find the conclusion that on the whole the rural school children are not up to the achievement of the city pupils, particularly in grades 6,7, and 8.

A Georgia survey[1] reports similar findings, in which the pupils' ability in arithmetic was consistently lower in the rural schools than in cities elsewhere.

J. Cayce Morrison in 1921 conducted a testing program in 43 one-room schools and 11 consolidated schools of New York State and found a consistent but small difference in arithmetic achievement in favor of the consolidated school.

1. The Survey of the Schools of Brunswick and of Glynn County, Georgia.

SPECIFIC DEFINITION OF PROBLEM

What is the relative achievement and the cost per unit of pupil progress made in arithmetic reasoning and computation, in the fourth, fifth, and sixth grades, in the one-room rural schools and the third class city schools of Ford County, Kansas, during an interval of six school months, the unit of measurement being one month's progress in Arithmetic Age per pupil.

DETAILED PROBLEMS

1. To obtain a measure of arithmetic achievement in computation and reasoning in grades four, five, and six in each type of school, using an initial test and following it with a test at the end of each two months, for a six month interval.

2. To compare in the two groups the initial achievement, the advance made, and the cost per unit.

3. To discover reasons for differences in achievement and cost which may be found to exist in the two groups.

THE METHOD OF PROCEDURE

As the interest and cooperation of teachers are essential in a study of this type, the writer went before the teachers in the Ford County teachers' institute in August, 1924, and enlisted their interest in the project, securing almost one hundred percent pledge of cooperation. A personal visit was then made to the third class cities of the county, three in number, and the city superintendents willingly gave their consent for their respective schools to enter the study.

Because of the fact that primary arithmetic varies widely in scope and nature as taught in different schools, it was thought best to exclude from the test the first three grades. Also, owing to the fact that junior high schools and departmentalized work in grades seven and eight applied in part of the schools, those grades were omitted from the comparative study. This left grades four, five, and six for this study to include.

The date of opening of schools is irregular, and likewise the closing date. The town schools had a nine-month term, and the rural schools an eight-month term. These conditions limited the time during which uniform tests could be given, and as it was thought advisable to allow a brief "warming up" period after the opening of school, the time was limited to a six month study.

The arithmetic section of the Stanford Achievement

Test was selected, together with its norms and age tables. Only forms A and B of this test were available, so it was decided to use form A for the first and third test, and form B for the second and fourth. However, none of the teachers or pupils knew what test was to be given at any time. As four months elapsed between the first and second use of the same test, and as no one knew it was to be used the second time, it is reasonable to consider the memory effect negligible.

In order to secure a measure of the mental age and ability of each group, the Haggerty Delta II mental test was sent to all schools to be given on the same date as the first arithmetic test, September 30,1924. Complete, typed instructions were given each teacher for administering all tests. Immediately following the tests, all papers were mailed to the writer, who together with his wife did all the scoring, checking and tabulating. The subsequent tests were handled in a similar manner, being given respectively on November 25, February 4, and April 1. As the school month was the unit of time for the study, the Christmas vacation was not included in the second interval, and as Tuesday was considered one of the most satisfactory days of the week for testing, that day was selected for each of the four tests.

The current expenses of operating the various schools of the county were obtained from the district treasurers'

annual financial report to the county superintendent. The term "current expenses" is used to include all expenses except for sites, new buildings, additions to buildings or refunding bonds.

Three fourths of the expenses of the eight month schools, and two thirds of the expenses of the nine month schools were used to represent the costs for the six month testing period, in the respective types of schools.

Questionnaires were sent to teachers to ascertain what portion of the day was devoted by the teacher to teaching arithmetic in the three grades studied. The replies gave an average of 35 minutes per day or 10.6 percent of the total teaching time of rural teachers, and 66 minutes per day, or 20 percent of the total teaching time of town teachers. The proportionate costs, therefore, of teaching arithmetic to these grades for a period of six months are shown in table 9. The total growth in months of arithmetic age as distributed in tables 5 and 6 divided into the total cost of teaching arithmetic gives the respective results of 44.9 cents for one-room rural schools and 55 cents for third class city schools as the cost of advancing a pupil one month in arithmetic age.

A few of the rural schools of the county did not participate in the study owing to the fact that some did not have any pupils in the grades studied, and in a few cases

the teachers gave the tests too irregularly to use the results. However, the study includes almost all pupils in the three grades throughout the county, and is thoroughly representative of the entire county.

The total number of pupils taking all or part of the tests was 235 in the rural group and 131 in the town group.

ANALYSIS OF TABLES

The chronological ages of the rural school pupils and those in the town schools were very similar as shown by Table 1 and Graph 1, the town pupils being in general slightly older than the rural pupils in the fourth grade, and younger in the fifth and sixth grades.

The scores made on the intelligence test as shown in Table 2 and Graph 2 indicate a slight superiority on the part of the town pupils in mental ability as measured by this test. Differences in performance in arithmetic must therefore be due to other factors than either chronological or mental age.

The scores in each arithmetic test are grouped in Table 3 and the medians shown in Graph 3. This indicates a consistent superiority in arithmetic achievement of the town school pupils. On the initial test given on September 30, there is a difference of 19.8 between the medians of each group. During the first interval of time, which

included October and November school months, the rate of progress was almost parallel as indicated by Graph 3, The difference in the medians of each group on November 25, the date of the second test, being 18.2. The second time interval shows a marked difference in progress in favor of the town group, the graph of the town pupils' median showing a slight acceleration over the preceding interval. On the other hand the rural pupils showed a decline during this period, the difference in the medians of the two groups being 25.3 on February 4th, the end of the second interval. This falling off in the achievement of the rural pupils occurred during the months of December and January, and is probably due largely to irregularity of attendance, shown by the falling off in the number taking the tests in the winter months. The third interval shows a decided reverse in the relative rates of progress of the two groups. The median graph of the town pupils declines, and that of the rural pupils takes a sharp up-turn with a resulting difference in medians of but 16.1 on April 1st, the date of the last test. This retardation toward the end of the learning period as shown by the town pupils is typical of most learning curves, but such a marked acceleration as the rural group shows in the same period is difficult to account for. It is probably true that teachers and pupils were making an extra effort in the last interval to overcome their handicap of irregular attendance earlier in the winter. The final test showed

a slightly superior gain on the part of the rural children during the entire six-month period, but they were still distinctly below the town group in arithmetic ability as measured by the test.

FIGURING UNIT COSTS

Table 7 gives the total current expense of the rural schools in the study. Three eighths of this is charged to the three grades 4 , 5, and 6. As the rural schools all had eight month terms, three fourths of the expense represents the cost of operating during the six months interval involved in the experiment. A questionnaire sent to the rural teachers at the close of school revealed an average of 35 minutes per day devoted by the teacher to arithmetic in the three grades, or 10.6 percent of the total time of each teacher. Hence this proportion of expense is charged to the subject of arithmetic.

Similarly, Table 8 shows the costs of the three grades in the town schools. These figures were obtained by adding the salaries of teachers to three eighths of the other expenses of the elementary grades. The length of term being nine months, two thirds of the cost was used for the six month period. A questionnaire showed an average of 66 minutes per day or 20 percent of the total time, devoted by the town teachers to arithmetic in the grades concerned.

Table 9 sums up these data showing a cost of 44.9 cents

for advancing a rural school pupil one month in arithmetic age, and 55 cents for a town pupil under the limitations of this study.

Several factors are responsible for the higher cost in the town schools. Salaries of the town teachers average considerably higher than rural salaries. However the chief explanation of higher teaching costs in the town schools lies in column d of Table 9 which shows that town teachers devote almost twice as large a percentage of their time to arithmetic in these grades as do the rural teachers, and the results in the town schools do not show corresponding returns. As a matter of fact, children in the one-room school learn much from hearing the recitations of higher classes. It should be noted also that the very nature of circumstances in the rural school tend to develop more independence in pupils' working, thus operating again in favor of lower unit costs in rural school achievement.

CONCLUSIONS

1. Little difference was found in age-grade progress between the two groups studied: ie. the fourth, fifth, and sixth grade pupils in the one-room rural schools and the third class city schools of Ford County.

2. A very slight superiority of town pupils was found in mental ability as measured by the Haggerty Delta II Intelligence Test.

3. The town pupils of Ford County in the grades studied are more advanced in arithmetic than the one-room rural school pupils.

4. During the period tested, the rural pupils made slightly more gain in arithmetic than those in the towns.

5. The actual cost of advancing a Ford County rural pupil of the above grades one month in arithmetic age according to the Stanford Achievement Test and age tables is 44.9 cents as compared to 55 cents for the town pupil.

6. The difference in cost seems to be due to three factors: higher salaries in the town schools, a larger proportion of town teachers' time devoted to arithmetic without corresponding returns in achievement, and rural pupils' opportunity to absorb knowledge from hearing recitations of other classes.

SUMMARY

The Arithmetic section of the Stanford Achievement Test was given to the 4th, 5th, and 6th grade pupils in the one-room rural schools and the third class city schools of Ford County, Kansas, four times during an interval of six school months beginning September 30, 1924, and closing April 1, 1925. Forms A and B of the test were alternated for the purpose. The Haggerty Dalta II Intelligence Test was also given on the first date.

The results of the arithmetic tests showed the rural group lower in achievement throughout each test, but their gain was relatively higher than the town group for the six month period.

The scores were translated into arithmetic ages, and the total gain in months of arithmetic age was calculated for each group.

The cost of teaching arithmetic for the six months was calculated for each type of school on the basis of proportion of time. This cost divided by the total number of months gained in arithmetic age gave 44.9 cents and 55 cents as the cost of advancing a pupil one month in arithmetic age in the rural and town schools respectively.

The chief reasons found for the difference in cost are: higher salaries for town teachers, incidental learning of rural pupils from hearing advanced pupils recite, and especially the longer time devoted to teaching arithmetic in the town schools without securing proportionate results.

TABLES AND GRAPHS

Table 1.

Chronological Ages in Months, Sept.30,1924.

Months Interval	No. Rural Pupils			No. Town Pupils		
	Grade 4	Grade 5	Grade 6	Grade 4	Grade 5	Grade 6
86 - 90				1		
91 - 95						
96 - 100	4			3		
101 - 105	4			2		
106 - 110	13	3		6	4	
111 - 115	24	1		4	3	
116 - 120	12	12	4	8	4	
121 - 125	10	13	2	6	5	2
126 - 130	6	11	4	6	9	3
131 - 135		9	10	1	6	9
136 - 140	5	9	5	1	4	5
141 - 145	1	8	11	1	2	8
146 - 150		3	8	2	3	3
151 - 155	1	3	5		1	2
156 - 160	1	1	4			1
161 - 165		1	4		1	4
166 - 170			6			1
171 - 175	1	1	1			
176 - 180					1	1
181 - 185					1	
186 - 190			1			

Quartiles and Medians of Table 1.

	Rural Pupils' Ages in Months			Town Pupils' Ages in Months		
	Grade 4	Grade 5	Grade 6	Grade 4	Grade 5	Grade 6
Q_1	111.1	122	134.1	109.5	121	133.6
M	115.3	130.1	144.6	119.1	129.6	141.6
Q_3	124.8	140	155.8	126.6	138.5	149.8

Graph 1.

Chronological Ages in Months

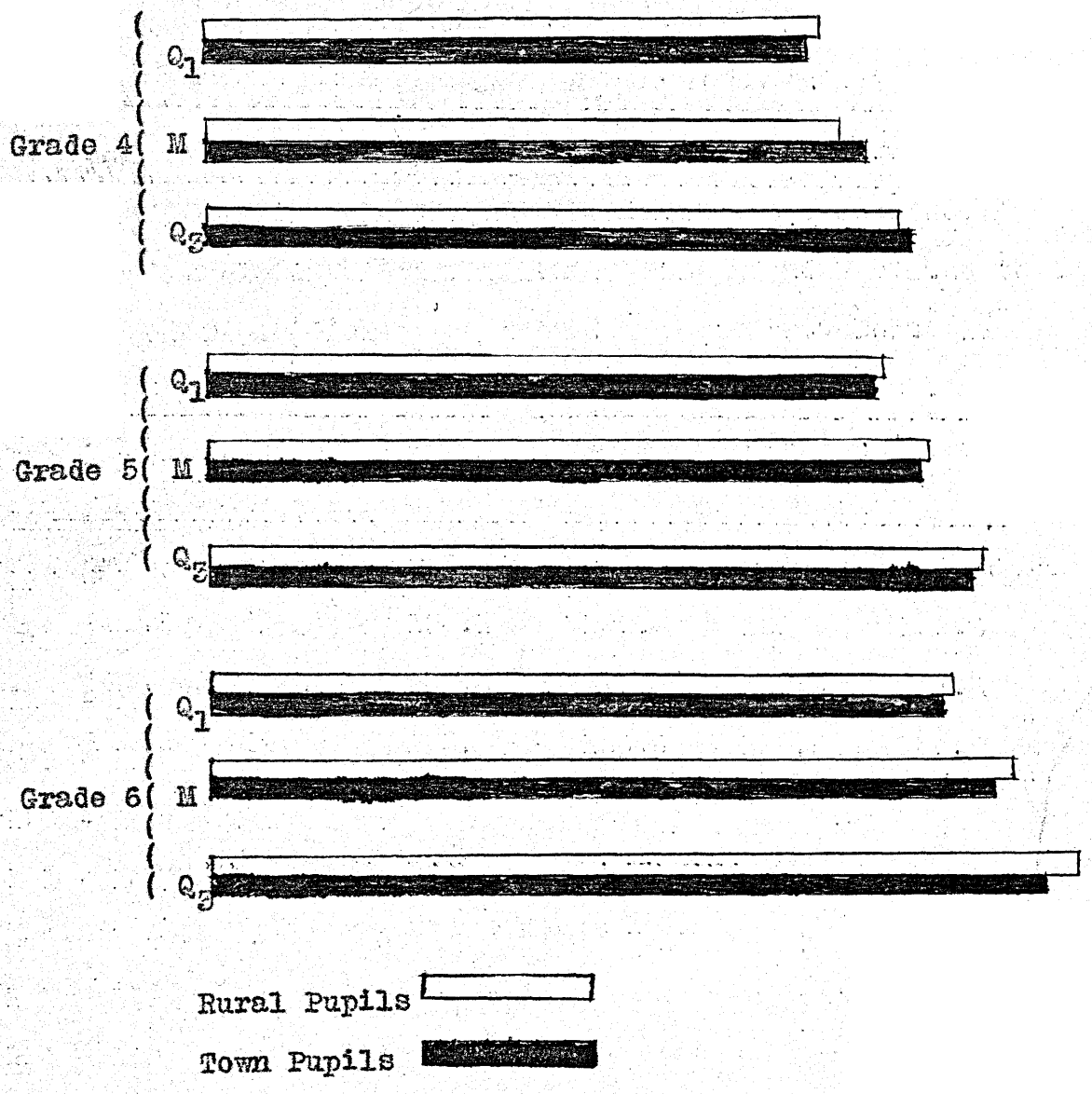


Table 2.

Scores on Haggerty Delta II Intelligence Test

Scores	No. Rural Pupils	No. Town Pupils
1 - 10	1	
11 - 20	9	2
21 - 30	16	9
31 - 40	27	9
41 - 50	37	16
51 - 60	28	24
61 - 70	36	16
71 - 80	17	21
81 - 90	18	6
91 - 100	8	6
101- 110	1	2
111- 120	3	5

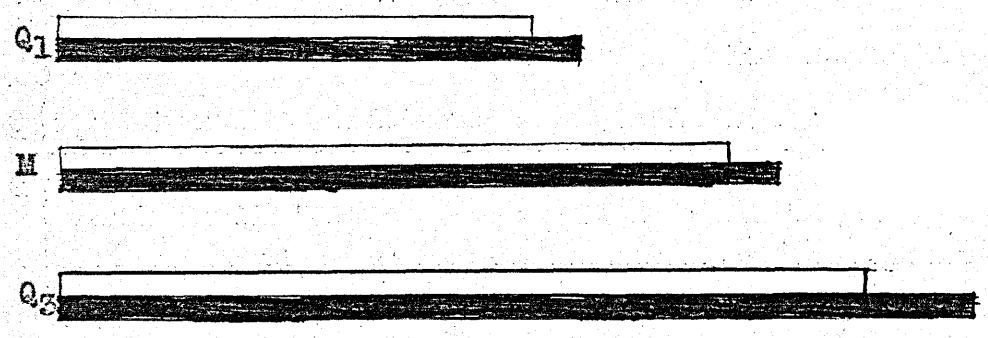
Medians and Quartiles of Table 2.

	Rural Pupils' Scores	Town Pupils' Scores
Q_1	40	44
M	56	59.5
Q_3	68	77

Note: The above point measures were obtained before grouping the scores.

Graph 2.

Haggerty Delta II Intelligence Test Scores



Rural Pupils

Town Pupils

Table 3.

Arithmetic Scores

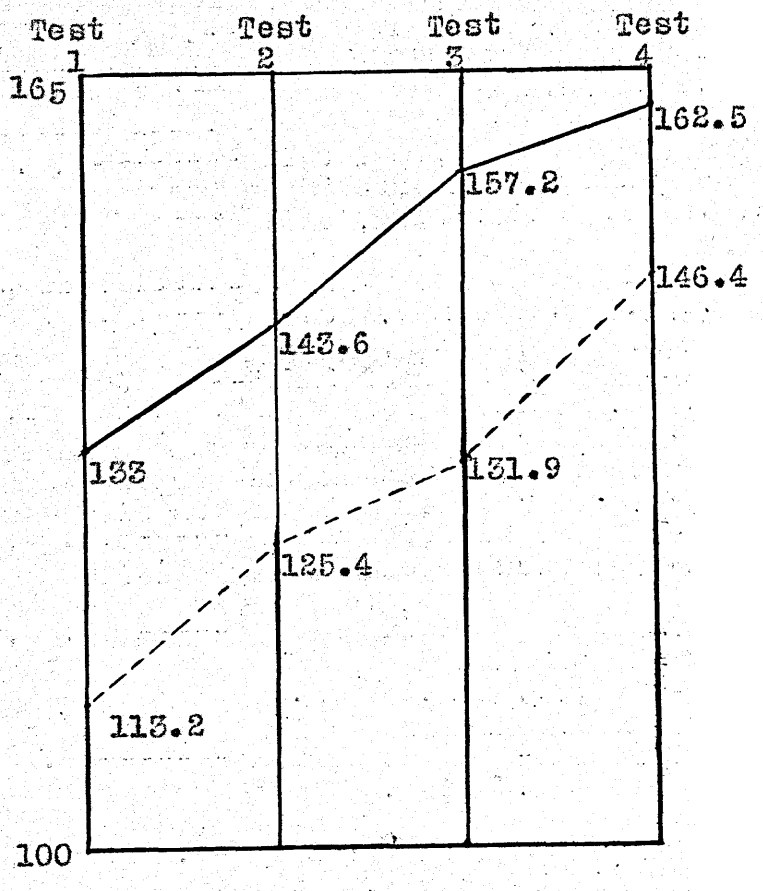
Scores	No. Rural Pupils				No. Town Pupils			
	Test1	Test2	Test3	Test4	Test1	Test2	Test3	Test4
21 - 32	1							
33 - 44	4	1				1		
45 - 56	6				2			
57 - 68	12	7	4		1	3		1
69 - 80	11	7	2	4	5	5		1
81 - 92	16	8	11	4	7	5	2	1
93 - 104	32	19	12	5	10	6	10	4
105- 116	27	25	23	18	9	8	8	2
117- 128	22	28	23	27	19	11	8	10
129- 140	32	25	31	24	12	17	16	11
141- 152	20	23	14	31	6	14	8	16
153- 164	8	16	25	29	16	18	17	17
165- 176	6	10	13	23	16	9	10	13
177- 188	2	2	3	13	7	10	19	11
189- 200			3	7	2	8	9	11
201- 212	2	1		3	2	1	5	7
213- 224			1	1		2	2	5
225- 236		1		3			1	3
237- 248							1	3
249- 260								2
261- 272								1

Medians and Quartiles of Table 3.

Test No.	Rural Pupils			Town Pupils		
	Q_1	M	Q_3	Q_1	M	Q_3
1	93.1	113.2	136.4	109.9	133	163.9
2	105.6	125.4	146.1	118.6	143.6	165.7
3	111.4	131.9	154.8	129.8	157.2	182
4	124.5	146.4	166	140.7	162.5	191.5

Graph 3

Medians of Arithmetic Scores



——— Median of Town Pupils

----- Median of Rural Pupils

Table 4.

Improvement in Arithmetic Scores

Increase in Score	Rural Pupils Intervals			Town Pupils Intervals		
	1st	2nd	3rd	1st	2nd	3rd
0 - 3	51	50	36	45	35	33
4 - 7	7	4	15	14	6	10
8 - 11	15	10	10	6	6	10
12 - 15	13	16	12	8	9	11
16 - 19	11	14	13	7	10	3
20 - 23	16	10	11	9	11	4
24 - 27	11	6	12	6	5	10
28 - 31	8	11	9	8	10	11
32 - 35	6	6	8	1	3	5
36 - 39	5	2	5	3	2	3
40 - 43	2	2	5	3	5	3
44 - 47	4	2	3		3	2
48 - 51	5		1	1	4	1
52 - 55	1	1	1		1	1
56 - 59		1	3			1
60 - 63	2	1		1	1	
64 - 67					1	
68 - 71	1					1
72 - 75			1		1	1
76 - 79						1

Quartiles and Medians of Table 4

	Rural Pupils			Town Pupils		
	1st Interval	2nd Interval	3rd Interval	1st Interval	2nd Interval	3rd Interval
Q_1	3	2.7	4.7	2.5	3.2	3.4
M	13.8	13	15.8	7.1	13.3	12.9
Q_3	26	23.2	27.9	21.8	29.4	28.8

Table 5

Growth in Months of Arithmetic Age - Town Pupils

Months Gain in A.A.	First Interval	Second Interval	Third Interval
0 - 2	58	41	42
3 - 5	11	12	15
6 - 8	12	15	11
9 - 11	10	13	10
12 - 14	9	13	11
15 - 17	4	4	7
18 - 20	5	4	5
21 - 23	1	5	4
24 - 26	2	2	1
27 - 29		1	2
30 - 32		1	
33 - 35		2	2
36 - 38			
39 - 41			1

Medians and Quartiles of Table 5.

	Months Gained in A.A.		
	First Int.	Second Int.	Third Int.
Q_1	1.4	2.1	2
M	2.9	6.7	5.7
Q_3	9.9	12.9	13.4

Table 6.

Growth in Months of Arithmetic Age - Rural Pupils

Months Gain in A.A.	First Interval	Second Interval	Third Interval
0 - 2	59	54	47
3 - 5	24	20	20
6 - 8	25	26	19
9 - 11	16	11	21
12 - 14	12	16	11
15 - 17	10	2	12
18 - 20	5	3	6
21 - 23	3	2	7
24 - 26	2	2	
27 - 29	1		
30 - 32	1		1
33 - 35			
36 - 38			1

Quartiles and Medians of Table 6.

	Months Gained in A.A.		
	First Interval	Second Interval	Third Interval
Q_1	2	1.7	2.3
M	5.5	5.1	6.9
Q_3	11	9.5	12.5

Table 7.

Current Expenses of Districts

Dist. No.	Current Expense Year 1924-25
6	$1092.92
7	976.30
8	1407.85
9	1240.02
14	927.13
15	2741.52
16	1958.85
18	2223.64
19	1049.97
20	1236.22
21	912.48
22	1248.42
23	1224.78
25	1220.57
30	2247.86
31	1041.88
32	1090.77
34	1257.40
35	877.99
37	1810.46
38	980.14
42	1036.22
45	1042.34

Table 7 continued.

46	914.30
50	1734.03
52	1389.60
53	878.62
54	1345.05
55	1005.92
57	1085.22
58	948.57
60	1128.42
61	1028.36
62	911.05
63	1113.16
65	832.10
68	966.68
Total Expense	$45908.21

Table 8.

Current Expenses of Town Schools

Town	Teachers' Salaries for 4th 5th & 6th gds.	Three eighths of other current expense of elementary grades, 1924-25	Total Current Expense
Spearville	$1485.00	$ 715.00	$2200.00
Ford City	1355.00	391.02	1746.02
Bucklin	2880.00	1312.00	4192.00
Totals	$5720.00	$2418.02	$8138.02

Table 9

Unit Cost Data

	a	b	c	d	e	f	g
Rural Schools	$45908.21	17215.58	12911.69	10.6%	1368.64	3048	.449
Town Schools		8138.02	5425.35	20%	1085.07	1974	.55

a. Total expense of all grades.
b. Proportionate expense of the three grades studied.
c. Proportionate expense for 6 months, $\frac{2}{4}$ and $\frac{2}{3}$ respectively of b.
d. Proportion of school day devoted to 4th, 5th, and 6th grade arithmetic.
e. Corresponding proportion of expense charged to arithmetic.
f. Total number of months gained in Arithmetic Age by all pupils, obtained from individual pupil data.
g. Cost per pupil per month, column e divided by column f.

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